

**Abstract of the Invention**

The present invention discloses a process and apparatus for removing sodium and chloride ions from an aqueous sodium chloride solution, such as seawater or brine. The process includes electrolyzing aqueous sodium chloride to remove chloride and sodium ions in the form of chlorine gas and sodium metal. Preferably, a photovoltaic device, such as a triple junction amorphous silicon solar cell, provides the electrical energy for the electrolysis. The process utilizes electrode material that facilitates the production of chlorine gas and inhibits the evolution of hydrogen from the aqueous sodium chloride solution. The sodium is deposited onto a metal surface having a high hydrogen overpotential to produce sodium amalgam. The processed solution from the electrolysis has a reduced sodium chloride content and may be further processed to produce fresh water for human consumption or agricultural purposes. The sodium amalgam is removed from the aqueous sodium chloride solution and transported to and coupled against an air depolarizing fuel cell in water to produce electrical power with the sodium air fuel cell, power that may be used to operate the apparatus or other machinery. The product of the reaction between the sodium amalgam and the fuel cell is sodium hydroxide that may be reacted with the chlorine gas to produce sodium hypochlorite.